



DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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CS6401 Computer Graphics

L-T-P-Cr: 3-0-0-3

Pre-requisites: Introduction to Computing, Data Structures, Computer Organization and Architecture.

Objectives/Overview:

- To cover fundamental principles of computer graphics based on underlying mathematical model for computer-generated image-data synthesis.
- Algorithmic implementation of above principles in suitable programming languages.

Course Outcomes – After completing this course, students should be able to:

- CO-1. *recall* theories of image-data rendering in computer-graphics systems;
- CO-2. *express* elementary concepts of computer graphics in explaining advanced concepts and related solutions to render complex images in computer-graphics systems;
- CO-3. *demonstrate* methodologies used in building primitives for computer-graphics systems;
- CO-4. *determine* performance complexities of different image-data rendering approaches in computer-graphics systems.

Course Outcomes–Cognitive Levels–Program Outcomes Matrix –

[S: Strong relation (3); M: Moderate relation (2); W: Weak relation (1); N: No relation (0)]

Course Outcomes	Cognitive Levels	Program Outcomes											
		PO-1 (Engineering knowledge)	PO-2 (Problem analysis)	PO-3 (Design/development of solutions)	PO-4 (Conduct investigations of complex problems)	PO-5 (Modern tool usage)	PO-6 (The engineer and society)	PO-7 (Environment and sustainability)	PO-8 (Ethics)	PO-9 (Individual and team work)	PO-10 (Communication)	PO-11 (Project management and finance)	PO-12 (Life-long learning)
CO-1	Knowledge	S	S	S	W	W	W	M	W	M	S	W	S
CO-2	Comprehension	S	S	S	M	W	M	M	M	M	S	W	S
CO-3	Application	S	S	S	W	S	M	S	S	M	S	W	S
CO-4	Analysis	S	S	S	W	W	M	M	S	M	S	W	S

Unit I: Introduction

Lectures: 11

Introduction to computer graphics; Graphics input and output devices; Raster scan and random scan display; Coordinate reference system; Graphics software and libraries.

Primitives: Basic graphics primitives; Line-drawing algorithms; Antialiasing; Polyline and parallel line-drawing algorithms; Circle-generating algorithms; Ellipse-generating algorithms; Scan-conversion of conic section; Filled-area primitives.

Unit II: 2D Transformations, Viewing & Clipping

Lectures: 9

2D Transformations: Basic transformations; Homogeneous coordinate system; Composite transformations.

2D Viewing & Clipping: Viewing pipeline; Clipping window; Viewport transformations; Line clipping and polygon clipping algorithms; Curve and text clipping.

Unit III: 3D Object Representations, Transformations, Viewing & Clipping Lectures: 13

3D Object Representations: Polygon, quadric and superquadric surfaces; Spline curves and surfaces; Spline-drawing algorithms; Fractals and fractal dimension; Fractal geometry methods and generation procedures.

3D Transformations, Viewing & Clipping: Basic and composite transformations; Viewing pipeline and viewing-coordinate system; Viewport transformation; Parallel and perspective projections; Projection transformation; Line clipping and polygon clipping algorithms.

Unit IV: Visible Surface Detection & GPU Architectures

Lectures: 9

Visible Surface Detection, Illumination & Shading: Visible surface detection algorithms; Depth cueing; Illumination and shading; Illumination models; Shading methods; Global illumination; Ray tracing; Radiosity lighting.

GPU Architectures: Graphics processing units; GPU stream model; GPU pipeline; GPU and CUDA programming.

Text/Reference Books:

1. Donald D. Hearn, M. Pauline Baker and Warren Carithers, *Computer Graphics with OpenGL*, Pearson Education, Fourth edition, 2014.
2. John Vince, *Mathematics for Computer Graphics*, Springer-Verlag, Fifth edition, 2017.
3. Donald D. Hearn and M. Pauline Baker, *Computer Graphics: C Version*, Pearson Education, Second edition, 1997.
4. Steve Marschner and Peter Shirley, *Fundamentals of Computer Graphics*, CRC Press, Fourth edition, 2016.
5. Sumanta Guha, *Computer Graphics Through OpenGL: From Theory to Experiments*, CRC press, Third edition, 2019.
6. John F. Hughes, Andries Van Dam, James D. Foley, Morgan McGuire, Steven K. Feiner, David F. Sklar, and Kurt Akeley, *Computer Graphics: Principles and Practice*, Addison-Wesley, Third edition, 2014.
7. David A. Patterson, John L. Hennessy, *Computer Organization and Design: The Hardware/Software Interface*, Morgan Kaufmann, Fifth edition, 2014.
8. John L. Hennessy, David A. Patterson, *Computer Architecture: A Quantitative Approach*, Morgan Kaufmann, Sixth edition, 2017